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**AN INVESTIGATION OF THE SMOKE PRODUCED BY
INTERIOR BULKHEAD FINISHES
AND
SECONDARY DECK COVERINGS**

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Marine Fire and Safety Research Division
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16. Abstract <i>not in test</i> This report provides data on the quantity of smoke produced by commercial materials used on ships as interior bulkhead finish and secondary deck coverings. The quantity of smoke produced was determined using the procedures outlined in the smoke obscuration test protocol proposed by the International Maritime Organization (IMO) in FP 33/WP.3, paragraph 3.9. Bulkhead finish materials that were tested included: paints and coatings; vinyl chloride films; and laminates. Secondary deck coverings that were tested included: paints and carpets. <i>Keywords: Interior Finishes, Ship Fire Safety, Fire Test.</i>					
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Conversions from Metric Measures

When you know (symbol)	Multiply by	To find (symbol)
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$\frac{1}{3}$	3	$\frac{1}{3}$
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Length			
inches (in)	2.540	centimeters (cm)	
feet (ft)	30.48	centimeters (cm)	
feet (ft)	0.3048	meters (m)	
Area			
square inches (in ²)	6.452	square centimeters (cm ²)	
square feet (ft ²)	929.0	square centimeters (cm ²)	
square feet (ft ²)	0.09290	square meters (m ²)	
Volume			
fluid ounces, US (fl oz)	29.57	milliliters (ml); cubic centimeters (cm ³)	
gallons, US liquid (gal)	3.785	liters (l)	
cubic feet (ft ³)	0.02832	cubic meters (m ³)	
cubic yards (yd ³)	0.7646	cubic meters (m ³)	
Mass (weight)			
ounces, avoirdupois (oz)	28.35	grams (g)	
pounds (lb)	0.4536	kilograms (kg)	
Density			
pounds per cubic inch (lb/in ³)	27.68	grams per cubic centimeter (g/cm ³)	
pounds per cubic foot (lb/ft ³)	16.02	kilograms per cubic meter (kg/m ³)	
Pressure			
pounds per square inch (psi)	6895	pascals (Pa); newtons per square meter (N/m ²)	
pounds per square inch (psi)	0.0703	kilograms per square centimeter (kg/cm ²)	
pounds per square inch (psi)	51.71	millimeters of mercury (mm Hg) at 0°C	
pounds per square inch (psi)	0.06895	bars (10 ⁵ N/m ²)	
inches of water (in H ₂ O) at 60°F	1.867	millimeters of mercury (mm Hg) at 0°C	
inches of water (in H ₂ O) at 60°F	248.9	pascals (Pa)	
inches of water (in H ₂ O) at 60°F	0.002489	bars (10 ⁵ N/m ²)	
inches of mercury (in Hg) at 32°F	3386	pascals (Pa)	
inches of mercury (in Hg) at 32°F	0.03386	bars (10 ⁵ N/m ²)	
Energy			
British thermal units (Btu)	1055	joules (J); newton-meter (Nm)	
British thermal units (Btu)	0.2520	kilocalories (kcal)	
Thermal Conductance			
Btu / hr · ft ² · °F	0.0001356	calories / sec · cm ² · °C	
Btu / hr · ft ² · °F	0.4882	calories / hr · cm ² · °C	
Btu / hr · ft ² · °F	0.0005678	watts / cm ² · °C	
Heat Flow			
Btu / hr · ft ²	0.00007535	calories / sec · cm ²	
Btu / hr · ft ²	0.2712	calories / hr · cm ²	
Btu / hr · ft ²	0.0003154	watts / cm ²	

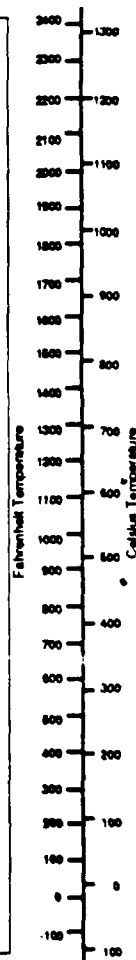


TABLE OF CONTENTS

	Page
1.0 BACKGROUND.....	1
2.0 EXPERIMENTAL.....	1
3.0 RESULTS.....	1
4.0 DISCUSSION.....	3
5.0 CONCLUSIONS/RECOMMENDATIONS.....	4
 APPENDIX A. LIST OF MATERIALS	
A-1. Interior Bulkhead Finishes.....	A-1
A-2. Secondary Deck Coverings.....	A-2
 APPENDIX B. TEST DATA.....	 B-1

LIST OF TABLES

	Page
Table 1. Specific Optical Density, $D_m(\text{corr.})$ for Interior Bulkhead Finishes.....	2
Table 2. Specific Optical Density, $D_m(\text{corr.})$ for Secondary Deck Covering Material.....	2



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1.0 BACKGROUND

→ The International Maritime Organization (IMO) is considering the development and use of regulations which would restrict the use of shipboard materials that produce smoke when exposed to fire. Materials to be restricted include bulkhead finishes and secondary deck coverings. After a review of alternative test procedures, the test protocol developed by the American Society for Testing and Materials (ASTM E 662-83) was considered to be most suitable for use as an international standard (FP 33/WP.3/Add.1)*. This paper outlines the results of an investigation of the quantity of smoke produced by interior bulkhead finishes and secondary deck coverings.

2.0 EXPERIMENTAL

The ASTM E 662-83 test protocol was used to determine smoke obscuration. All tests were made using a Model 40580060 "Smoke Density Chamber" manufactured by the American Instrument Company. In order to determine the smoke density, measurement is made of the attenuation of a light beam by smoke accumulating within a closed chamber due to nonflaming decomposition and flaming combustion. The imposed fire load on the test sample is simulated by the radiant heat flux from an electrically heated furnace.

Prior to the start of these tests, the operation of the equipment and laboratory procedures were verified by determining the smoke obscuration values for standard reference materials subjected to flaming and nonflaming exposures. These materials are available from the U.S. National Institute of Standards and Technology (NIST) and designated NIST as Materials 1006 and 1007a.

Bulkhead finish tests included three classes of materials: coatings, polyvinyl chloride films, and laminates. The bulkhead finish materials were applied to 1/2 inch Marinite, a noncombustible marine board, or a glass reinforced cement (GRC) board. The laminates were fabricated using a hot press technique. The vinyl films were applied using adhesives recommended by the manufacturers. The coatings were applied at application rates recommended by the manufacturer. Results for two paints applied to 3/16 inch steel are included for comparison.

3.0 RESULTS

Results for the interior bulkhead finish materials are summarized in Table 1. For the laminates $D_m(\text{corr.})$ values were 100 or below for both flaming and nonflaming exposures. For vinyl wallcoverings, these went from 47 to 236. One vinyl wallcovering was at

* Minutes of the IMO Sub-Committee on Fire Protection (Session 33, 18 February 1988).

or below 50 for both exposures. For paints/coatings Dm(corr.) values were below 150. When applied to a steel bulkhead these were below 40.

Table 1. Specific Optical Density, Dm(corr.), for Interior Bulkhead Finishes.

Lab. Mark	Description	Substrate	Dm(corr.) Flaming/Nonflaming
M1	Laminate	GRC	28/105
M1	Laminate	Marinite	51/79
M3	Laminate	Marinite	11/27
M15	Laminate	Marinite	19/33
M16	Laminate	Marinite	43/59
M17	Laminate	Marinite	28/72
M8	Vinyl Film	Marinite	108/122
M9	Vinyl Film	Marinite	50/47
M18	Vinyl Film	Marinite	48/176
M20	Vinyl Film	Marinite	317/236
M5	Coating/Paint	Marinite	37/59
M21	Coating/Paint	Marinite	43/142
M22	Coating/Paint	Marinite	101/82
M31	Coating/Paint	Steel	38/12
M33	Coating/Paint	Steel	6/5

Table 2. Specific Optical Density Data, Dm(corr.) for Secondary Deck Covering Materials.

Lab. Mark	Description	Substrate	Dm(corr.) Flaming/Nonflaming
M31	Epoxy Paint	Steel	38/12
M33	Primer	Steel	6/5
M36	100% Wool Carpet	Steel	394/72
M38	80% Wool Carpet	Steel	320/351
M39	50% Mohair Carpet	Steel	480/282
M40	100% Nylon Carpet	Steel	19/59
M41	100% Nylon Carpet	Steel	38/54
M102	100% Nylon Carpet	Steel	139/58
M104	100% Nylon Carpet	Steel	108/50
	Red Oak	n/a	300/505

Secondary deck covering tests included two types of materials: coatings, and carpets. Since these materials would be applied directly to the deck, the test samples were applied to 3/16 inch steel plates. Two coatings were evaluated; an industrial primer and an epoxy paint. Eight carpets were evaluated. These carpets were recommended by local suppliers for boats and included a 100% wool fabric as a standard, together with wool blends, and nylon. All carpets were applied to 3/16 inch steel plates using a commercial marine carpet adhesive.

Results for the secondary deck covering tests are summarized in Table 2. Values for $D_m(\text{corr.})$ for the two paints were less than 40 for both flaming and nonflaming exposures. Values for $D_m(\text{corr.})$ for the carpets were significantly higher.

With one exception, the wool and wool blends were much higher than either the paints or the nylon carpets. Maximum values for the specific optical density of wool carpets ranged between 351 to 480. Maximum values for the nylon carpets went from 59 to 139. Nylon carpet materials M40 and M102 were different thicknesses of ANTRON III, a 100% nylon fabric. Similarly, materials M41 and M104 are made from the same nylon base fiber. M102 and M104 had thicker piles than M40 and M41, respectively. For these materials the thicker piles have higher $D_m(\text{corr.})$ values.

4.0 DISCUSSION

The fire exposure conditions used in the ASTM E-662 test method correspond most closely to preflashover thermal fluxes. As such, they are believed to be relevant to the life safety of occupants in the room of fire origin or, in some instances, in immediately adjoining passages. Engineering methods for interpreting the values for $D_m(\text{corr.})$ are under development but have not yet been fully validated. Lacking a valid engineering method, a pragmatic approach can be used in which the available materials are rank ordered with respect to D_m . Pass/Fail criteria are then set based on the availability of having commercial materials within the specified D_m range, and the subjective judgement of the authority having jurisdiction.

These tests have shown that for all three categories of interior bulkhead finish, there are commercially available materials which have $D_m(\text{corr.})$ values of 100 or less. The laminates that were tested were consistantly low, usually below 70. One vinylchloride film was less than 50, the remainder had higher values. One paint had a $D_m(\text{corr.})$ of 59 for nonflaming exposures and another of 43 for flaming exposures when mounted on Marinite. Two paints had values below 38 for both flaming and nonflaming exposures when mounted on steel.

Similarly, there are commercially available secondary deck covering materials (both paints and carpets) which have $D_m(\text{corr.})$

values less than 60 when mounted on steel. Two 100% nylon filament fibers are in this latter category. The wool and wool blends had significantly higher values.

These results show that a rank order analysis permits the assignment of upper limiting values for both flaming and nonflaming exposures of 100 for interior finish applied to Marinite and 60 for secondary deck coverings applied directly to steel. The question of the relationship of these values to the true fire hazard, or to existing pass/fail criteria used by the U.S. Coast Guard based on data from ASTM E 84 tests has not been determined.

5.0 CONCLUSIONS/RECOMMENDATIONS

The ASTM E 662-83 test is a suitable test for IMO use in providing rank order information on the quantity of smoke generated by materials during the preflashover stage of ship compartment fires.

The $D_m(\text{corr.})$ values were found to vary with respect to application variables such as thickness and type of substrate. For interior finish, it is recommended that the tests be performed on a Marinite substrate. For secondary deck coverings, it is recommended that the tests be made using steel, or the specific primary deck covering to which the materials are to be applied.

There are commercially available materials designed for use as interior bulkhead finishes which have $D_m(\text{corr.})$ values of 100 or less for both flaming and nonflaming exposures. Therefore, an upper limiting value of 100 is consistent with these test results for interior bulkhead finishes.

There are commercially available materials suitable for use as secondary deck coverings which have $D_m(\text{corr.})$ values of 60 or less for both flaming and nonflaming exposures. Therefore, an upper limiting value of 60 is consistent with these test results for secondary deck coverings.

APPENDIX A
LIST OF MATERIALS

A-1. INTERIOR BULKHEAD FINISHES

Lab. Mark*	Description
M1SP2	Laminate -- MICARTA TYPE PFR-1 -- Westinghouse Electric Company
M3SP2	Laminate -- Melamine Type 604 -- Thickness 0.79 mm, Weight 1.12 kg/m ² Ralph Wilson Plastics
M5SP2	Coating -- 590 Lo Perm Application Rate 0.74 m ² /l Marathon Industries, Inc.
M8SP2	Wallcovering -- Type K-2L Vinyl film material Thickness 0.38 mm, Weight 0.27 kg/m ² Borden Chemical Co.
M9SP2	Wallcovering --TYPE I-G Vinyl-- Thickness 0.53 mm, Weight 0.35 kg/m ² B.F. Goodrich Co.
M15SP2	Laminate -- CW23-23, Type 335 Research Test Specimen Ralph Wilson Plastics
M16SP2	Laminate -- CW23-23A, Type 350 Research Test Specimen Ralph Wilson Plastics
M17SP2	Laminate -- CW23-23B, Type 107 Research Test Specimen Ralph Wilson Plastics
M18SP2	Wallcovering -- Smooth White Vinyl -- Thickness 0.64 mm, Nonwoven backing
M20SP2	Wallcovering -- I.D. None A brown vinyl material

* The Lab. Mark is an alphanumeric designation where M() is the identification number of the test material and SP() is the type of substrate where: SP1 is GRC board, SP2 is Marinite marine board and SP3 is 3/16 inch steel.

A-1. INTERIOR BULKHEAD FINISHES (cont.'d)

M21SP2	Coating -- LO PERM --Trowled Application rate -- 0.62 m ² /l Marathon Industries, Inc.
M22SP2	Coating -- PERM SURE --Trowled Application rate -- 2.0 m ² /l Marathon Industries, Inc.

A-2. SECONDARY DECK COVERINGS

<u>Lab. Mark</u>	<u>Description</u>
M30SP3	Inorganic Zinc topcoat/Industrial primer Dimetcote 9, Ameron Protective Coating Division, Brea, CA.
M31SP3	Ameron epoxy topcoat/industrial primer Amerlock/400A1 - Epoxy/Aluminum Coating Ameron Protective Coating Division, Brea, CA.
M32SP3	Carboline 190 HB epoxy primer Carboline Inc., St. Louis, MO.
M33SP3	Albi 487S primer Stan Chem Inc., Berlin, CT.
M34SP3	Vinyl floor tile, 1/8 in. (3 mm), Carpetek, Waterford, CT.
M35SP3	Vinyl floor tile, 1/8 in. (3 mm), Corktone #802, D - 242 Kentile, Carpetek, Waterford, CT.
M36SP3	100% Wool carpet Carpet Giant New London, CT.
M37SP3	Woolex, 55% wool/45% acrylic carpet, Stratton Industries, Inc. Cartersville, GA.
M38SP3	Tretford, 80% wool/20% nylon carpet, UNICO, Inc., Dallas, TX.
M39SP3	Acousticord, 50% wool/50% synthetic carpet, 503 W, UNICO, Inc., Dallas, TX.
M40SP3	Dupont ANTRON III nylon carpet, Stratton Industries, Inc., Cartersville, GA.

A-2. SECONDARY DECK COVERINGS (cont.'d)

M41SP3	Badish Zeftron 500 "ZX" nylon carpet, Stratton Industries, Inc., Cartersville, GA.
M102	Antron III nylon filament carpet height 1/4 inch -- cut pile Manufacturer: Stratton Industries, Inc., P.O. Box 1007, Cartersville, GA, 30120
M103	Woolex 55% wool/45% acrylic carpet, Thickness 1/4 inch -- closed loop pile Manufacturer: Stratton Industries, Inc., P.O. Box 1007, Cartersville, GA, 30120
M104	Badische ZEFTRON, nylon carpet Thickness 3/16 inch -- random closed loop pile, Manufacturer: Stratton Industries, Inc., P.O. Box 1007, Cartersville, GA, 30120

APPENDIX B
TEST DATA

TEST DATA FOR MATERIAL M1

Laboratory Code: M1S1SP2* Nonflaming Test

Date: 880615**

Operator: db

Initial Weight: 58.4 gms

Final Weight: 54.2 gms

Percent Weight Loss: 7.2

Minimum transmission 14% at 17 minutes

$Dm(corr.) = Dm - Dc = 113 - 3 = 110$

Laboratory Code: M1S2SP2 Nonflaming Test

Date: 880615

Operator: db

Initial Weight: 57.3 gms

Final Weight: 53 gms

Percent Weight Loss: 7.5

Minimum transmission 16% at 17 minutes

$Dm(corr.) = Dm - Dc = 105 - 4 = 101$

Laboratory Code: M1S3SP2 Nonflaming Test

Date: 880616

Operator: db

Initial Weight: 56.6 gms

Final Weight: 51.5 gms

Percent Weight Loss: 9

Minimum transmission 15% at 18 minutes

$Dm(corr.) = Dm - Dc = 107 - 3 = 104$

Laboratory Code: M1S7SP2 Nonflaming Test

Date: --

Operator: db

Initial Weight: 58.8 gms

Final Weight: 53.8 gms

Percent Weight Loss: 8.5

Minimum transmission 15% at 18 minutes

$Dm(corr.) = Dm - Dc = 109 - 4 = 105$

Laboratory Code: M1S5SP2 Flaming Test

Date: 881025

Operator: db

Initial Weight: 58.42 gms

Final Weight: 56.07 gms

Percent Weight Loss: 4.02

Minimum transmission 60% at 3 minutes

$Dm(corr.) = Dm - Dc = 29 - 1 = 28$

* Material 1, Sample 1, Special Purpose Substrate 2, where SP1 is GRC Board, SP2 is Marinite and SP3 is 3/16 inch steel

** Year, Month, Day of Test.

TEST DATA FOR MATERIAL M3

Laboratory Code: M3S1SP2 Nonflaming Test
Date: 880818
Operator: db
Initial Weight: 58.2 gms
Final Weight: 53.0 gms
Percent Weight Loss: 9.0
Minimum transmission 62% at 12.5 minutes
 $Dm(\text{corr.}) = Dm - Dc = 27 - 1 = 26$

Laboratory Code: M3S2SP2
Date: 880818
Operator: db
Initial Weight: 57.3 gms
Final Weight: 52.6 gms
Percent Weight Loss: 8.2
Minimum transmission 63% at 12.5 minutes
 $Dm(\text{corr.}) = Dm - Dc = 26 - 1 = 25$

Laboratory Code: M3S3SP2 Nonflaming Test
Date: 880818
Operator: db
Initial Weight: 57.2 gms
Final Weight: 53.0 gms
Percent Weight Loss: 7.3
Minimum transmission 58% at 12.5 minutes
 $Dm(\text{corr.}) = Dm - Dc = 31 - 1 = 30$

Laboratory Code: M3S4SP2 Flaming Test
Date: 881026
Operator: db
Initial Weight: 57.0 gms
Final Weight: 54.4 gms
Percent Weight Loss: 4.5
Minimum transmission 82% at 3 minutes
 $Dm(\text{corr.}) = Dm - Dc = 11 - 1 = 0$

Laboratory Code: M3S5SP2 Flaming Test
Date: 881128
Operator: db
Initial Weight: 56.9 gms
Final Weight: 56.5 gms
Percent Weight Loss: 0.5
Minimum transmission flamed out at 2 minutes

Laboratory Code: M3S6SP2 Flaming Test
Date: 881128
Operator: db
Initial Weight: 57.2 gms
Final Weight: 56.7 gms
Percent Weight Loss: 0.8
Minimum transmission flamed out at 2 minutes

TEST DATA FOR MATERIAL M5

Laboratory Code: M5S1 Nonflaming Test
Date: 880614
Operator: db
 Initial Weight: 65.5 gms
 Final Weight: 58.3 gms
 Percent Weight Loss: 11
 Minimum transmission 34% at 11 minutes
 Dm(corr.) = Dm - Dc = 62 - 1 = 61

Laboratory Code: M5S2 Nonflaming Test
Date: 880614
Operator: db
 Initial Weight: 62.6 gms
 Final Weight: 56.1 gms
 Percent Weight Loss: 10.5
 Minimum transmission 36% at 11.5 minutes
 Dm(corr.) = Dm - Dc = 59 - 1 = 58

Laboratory Code: M5S3 Nonflaming Test
Date: 880614
Operator: db
 Initial Weight: 65.1 gms
 Final Weight: 58.5 gms
 Percent Weight Loss: 10
 Minimum transmission 35% at 115 minutes
 Dm(corr.) = Dm - Dc = 60 - 1 = 59

Laboratory Code: M5S4 Flaming
Date: 881211
Operator: whm
 Initial Weight:
 Final Weight:
 Percent Weight Loss:
 Minimum transmission
 Dm(corr.) = Dm - Dc = 38 - 1 = 37

TEST DATA FOR MATERIAL M8

Laboratory Code: M8S1 Nonflaming Test
Date: 881211
Operator: db
 Initial Weight: 60.2 gms
 Final Weight: 52 gms
 Percent Weight Loss: 13.6
 Minimum transmission 11% at 20 minutes
 Dm(corr.) = Dm - Dc = 127 - 5 = 122

Laboratory Code: M8S2 Nonflaming Test
Date: 881211
Operator: db
 Initial Weight: 60.0 gms
 Final Weight: 51.7 gms
 Percent Weight Loss: 14
 Minimum transmission 12% at 20 minutes
 $Dm(corr.) = Dm - Dc = 122 - 2 = 120$

Laboratory Code: M8S3 Nonflaming Test
Date: 881211
Operator: db
 Initial Weight: 60.0 gms
 Final Weight: 52.3 gms
 Percent Weight Loss: 13
 Minimum transmission 11% at 20 minutes
 $Dm(corr.) = Dm - Dc = 127 - 2 = 125$

Laboratory Code: M8S4 Flaming Test
Date: 881211
Operator: whm
 Initial Weight:
 Final Weight:
 Percent Weight Loss:
 Minimum transmission:
 $Dm(corr.) = Dm - Dc = 110 - 2 = 108$

TEST DATA FOR MATERIAL M9SP2

Laboratory Code: M9S1SP2 Nonflaming Test
Date: 880714
Operator: db
 Initial Weight:
 Final Weight:
 Percent Weight Loss:
 Minimum transmission 40% at 13 minutes
 $Dm(corr.) = Dm - Dc = 53 - 1 = 52$

Laboratory Code: M9S2SP2 Nonflaming Test
Date: 880714
Operator: db
 Initial Weight:
 Final Weight:
 Percent Weight Loss:
 Minimum Transmission 46% at 13 minutes
 $Dm(corr.) = Dm - Dc = 45 - 1 = 44$

Laboratory Code: M9S3SP2 Nonflaming Test
Date: 880715
Operator: db
Initial Weight:
Final Weight:
Percent Weight Loss:
Minimum transmission 46% at 11.5 minutes
 $Dm(corr.) = Dm - Dc = 45 - 1 = 44$

Laboratory Code: M9S4SP2 Flaming Test
Date: 881025
Operator: db
Initial Weight: 48.4 gms
Final Weight: 45.3 gms
Percent Weight Loss: 6.4
Minimum transmission 44% at 8 minutes
 $Dm(corr.) = Dm - Dc = 47 - 1 = 46$

Laboratory Code: M9S5SP2 Flaming Test
Date: 881025
Operator: db
Initial Weight: 53.8 gms
Final Weight: 50.7 gms
Percent Weight Loss: 5.7
Minimum transmission 35% at 8 minutes
 $Dm(corr.) = Dm - Dc = 60 - 1 = 59$

Laboratory Code: M9S6SP2 Flaming Test
Date: 881025
Operator: db
Initial Weight: 48.7 gms
Final Weight: 44.9 gms
Percent Weight Loss: 7.7
Minimum transmission 44% at 10 minutes
 $Dm(corr.) = Dm - Dc = 47 - 1 = 46$

TEST DATA FOR MATERIAL M15

Laboratory Code: M15S1 Nonflaming Test
Date: 880818
Operator: db
Initial Weight: 61.0 gms
Final Weight: 56.1 gms
Percent Weight Loss: 8
Minimum transmission 53% at 17 minutes
 $Dm(corr.) = Dm - Dc = 36 - 1 = 35$

Laboratory Code: M15S2 Nonflaming Test
Date: 880818
Operator: db
 Initial Weight: 61.2 gms
 Final Weight: 56.4 gms
 Percent Weight Loss: 7.8
 Minimum transmission 57% at 17 minutes
 $Dm(corr.) = Dm - Dc = 32 - 1 = 31$

Laboratory Code: M15S3 Nonflaming Test
Date: 880818
Operator: db
 Initial Weight: 60.7 gms
 Final Weight: 56.6 gms
 Percent Weight Loss: 6.7
 Minimum transmission 55% at 17 minutes
 $Dm(corr.) = Dm - Dc = 34 - 1 = 33$

Laboratory Code: M15S4 Flaming Test
Date: 881026
Operator: db
 Initial Weight: 60.3 gms
 Final Weight: 50.5 gms
 Percent Weight Loss: 16.3
 Minimum transmission 71% at 15 minutes
 $Dm(corr.) = Dm - Dc = 20 - 1 = 19$

TEST DATA FOR MATERIAL M16

Laboratory Code: M16S1 Nonflaming Test
Date: 880720
Operator: db
 Initial Weight:
 Final Weight:
 Percent Weight Loss:
 Minimum transmission 37% at 20 minutes
 $Dm(corr.) = Dm - Dc = 57 - 2 = 55$

Laboratory Code: M16S2 Nonflaming Test
Date: 880720
Operator: db
 Initial Weight:
 Final Weight:
 Percent Weight Loss:
 Minimum transmission 32% at 20 minutes
 $Dm(corr.) = Dm - Dc = 65 - 1 = 64$

Laboratory Code: M16S3 Nonflaming Test
Date: 880720
Operator: db
 Initial Weight:
 Final Weight:
 Percent Weight Loss:
 Minimum transmission 36% at 20 minutes
 Dm(corr.) = Dm - Dc = 59 - 1 = 58

Laboratory Code: M16S4 Flaming Test
Date: 881026
Operator: db
 Initial Weight: 64.6 gms
 Final Weight: 62.2 gms
 Percent Weight Loss: 3.8
 Minimum transmission 62% at 3 minutes
 Dm(corr.) = Dm - Dc = 27 - 1 = 26

Laboratory Code: M16S5 Flaming Test
Date: 881116
Operator: db
 Initial Weight: 64.4 gms
 Final Weight: 56.6 gms
 Percent Weight Loss: 12.1
 Minimum transmission 35% at 11 minutes
 Dm(corr.) = Dm - Dc = 60 - 1 = 59

Laboratory Code: M16S6 Flaming Test
Date: --
Operator: db
 Initial Weight: 63.2 gms
 Final Weight: 54.8 gms
 Percent Weight Loss: 13.2
 Minimum transmission 46% at 20 minutes
 Dm(corr.) = Dm - Dc = 45 - 1 = 44

TEST DATA FOR MATERIAL M17

Laboratory Code: M17S1 Nonflaming Test
Date: 880817
Operator: db
 Initial Weight: 66.9 gms
 Final Weight: 60.6 gms
 Percent Weight Loss: 8.7
 Minimum transmission 30% at 17 minutes
 Dm(corr.) = Dm - Dc = 69 - 0 = 69

Laboratory Code: M17S2 Nonflaming Test
Date: 880817
Operator: db
 Initial Weight: 64.2 gms
 Final Weight: 57.4 gms
 Percent Weight Loss: 10.6
 Minimum transmission 28% at 17 minutes
 Dm(corr.) = Dm - Dc = 73 - 0 = 73

Laboratory Code: M17S3 Nonflaming Test
Date: 880817
Operator: db

Initial Weight: 65.5 gms
Final Weight: 59.2 gms
Percent Weight Loss: 9.6
Minimum Transmission 28% at 17 minutes
 $Dm(corr.) = Dm - Dc = 73 - 0 = 73$

Laboratory Code: M17S4 Flaming Test
Date: 881121
Operator: db

Initial Weight: 65.5 gms
Final Weight: 62.9 gms
Percent Weight Loss: 4
Minimum Transmission 80% at 3 minutes
 $Dm(corr.) = Dm - Dc = 13 - 0 = 13$

Laboratory Code: M17S5 Flaming Test
Date: 881121
Operator: db

Initial Weight: 63.7 gms
Final Weight: 62.6 gms
Percent Weight Loss: 1.8
Minimum Transmission 88% at 2.5 minutes
 $Dm(corr.) = Dm - Dc = 7 - 0 = 7$

Laboratory Code: M17S6 Flaming Test
Date: 881025
Operator: db

Initial Weight: 64.7 gms
Final Weight: 54.3 gms
Percent Weight Loss: 16.1
Minimum Transmission 32% at 15 minutes
 $Dm(corr.) = Dm - Dc = 65 - 2 = 63$

TEST DATA FOR MATERIAL M18

Laboratory Code: M18S1SP2 Nonflaming Test
Date: 880718
Operator: db

Initial Weight:
Final Weight:
Percent Weight Loss:
Minimum Transmission 3.7% at 20 minutes
 $Dm(corr.) = Dm - Dc = 189 - 11 = 178$

Laboratory Code: M18S2SP2 Nonflaming Test
Date: 880718
Operator: db

Initial Weight:
Final Weight:
Percent Weight Loss:
Minimum Transmission 4.4% at 20 minutes
 $Dm(corr.) = Dm - Dc = 179 - 10 = 169$

Laboratory Code: M18S3SP2 Nonflaming Test
Date: 880718
Operator: db
Initial Weight:
Final Weight:
Percent Weight Loss:
Minimum Transmission 3.8% at 20 minutes
 $Dm(corr.) = Dm - Dc = 187 - 6 = 181$

Laboratory Code: M18S4SP2 Flaming Test
Date: 881122
Operator: db
Initial Weight: 51.6 gms
Final Weight: 48.0 gms
Percent Weight Loss: 7.0
Minimum Transmission
 $Dm(corr.) = Dm - Dc = 11 - 1 = 10$

Laboratory Code: M18S5SP2 Flaming Test
Date: 881025
Operator: db
Initial Weight: 53.2 gms
Final Weight: 48.9 gms
Percent Weight Loss: 8.1
Minimum Transmission 21% at 3 minutes
 $Dm(corr.) = Dm - Dc = 89 - 3 = 86$

TEST DATA FOR MATERIAL M20

Laboratory Code: M20S1 Nonflaming Test
Date: 880715
Operator: db
Initial Weight:
Final Weight:
Percent Weight Loss:
Minimum transmission 1.6% at 20 minutes
 $Dm(corr.) = Dm - Dc = 237 - 5 = 237$

Laboratory Code: M20S2 Nonflaming Test
Date: 880715
Operator: db
Initial Weight:
Final Weight:
Percent Weight Loss:
Minimum transmission 1.5% at 20 minutes
 $Dm(corr.) = Dm - Dc = 241 - 7 = 234$

Laboratory Code: M20S3 Nonflaming Test
Date: 880715
Operator: db
Initial Weight:
Final Weight:
Percent Weight Loss:
Minimum transmission 1.5% at 20 minutes
 $Dm(corr.) = Dm - Dc = 241 - 5 = 236$

Laboratory Code: M20S4 Flaming Test
Date: 881025
Operator: db
 Initial Weight: 53.5 gms
 Final Weight: 44.9 gms
 Percent Weight Loss: 16.2
 Minimum transmission 0.72% at 10 minutes
 Dm(corr.) = Dm - Dc = 283 - 1 = 282

Laboratory Code: M20S5 Flaming Test
Date: --
Operator: db
 Initial Weight: 54.6 gms
 Final Weight: 48.2 gms
 Percent Weight Loss: 11.7
 Minimum transmission 2.1% at 9 minutes
 Dm(corr.) = Dm - Dc = 353 - 1 = 352

TEST DATA FOR MATERIAL M21

Laboratory Code: M21S1SP2 Nonflaming test
Date: 8807--
Operator: db
 Initial Weight:
 Final Weight:
 Percent Weight Loss:
 Minimum Transmission 7.2% at 18 minutes
 Dm(corr.) = Dm - Dc = 151 - 2 = 149

Laboratory Code: M21S2SP2 Nonflaming Test
Date: 8807--
Operator: db
 Initial Weight:
 Final Weight:
 Percent Weight Loss:
 Minimum Transmission 8.1% at 18 minutes
 Dm(corr.) = Dm - Dc = 144 - 2 = 142

Laboratory Code: M21S3SP2 Nonflaming Test
Date: 8807--
Operator: db
 Initial Weight:
 Final Weight:
 Percent Weight Loss:
 Minimum Transmission 9.3% at 16.5
 Dm(corr.) = Dm - Dc = 136 - 1 = 135

Laboratory Code: M21S5SP2 Flaming Test
Date: 881117
Operator: db
 Initial Weight: 64.2 gms
 Final Weight: 64.2 gms
 Percent Weight Loss: 4.7
 Minimum Transmission 28% at 2 minutes
 Dm(corr.) = Dm - Dc = 73 - 1 = 72

Laboratory Code: M21S6SP2 Flaming Test
Date: 881117
Operator: db
Initial Weight: 64.7 gms
Final Weight: 62.7 gms
Percent Weight Loss: 3.2%
Minimum Transmission 68% at 1.5 minutes
 $Dm(corr.) = Dm - Dc = 22 - 0 = 22s$

Laboratory Code: M21S7SP2 Flaming Test
Date: 881025
Operator: db
Initial Weight: 64.6 gms
Final Weight: 61.0 gms
Percent Weight Loss: 5.5%
Minimum Transmission 52% at 3 minutes
 $Dm(corr.) = Dm - Dc = 37 - 1 = 36$

TEST DATA FOR MATERIAL M22

Laboratory Code: M22S1SP2 Nonflaming Test
Date: 880715
Operator: db
Initial Weight:
Final Weight:
Percent Weight Loss:
Minimum Transmission 19% at 20 minutes
 $Dm(corr.) = Dm - Dc = 95 - 7 = 88$

Laboratory Code: M22S2SP2 Nonflaming Test
Date: 880715
Operator: db
Initial Weight:
Final Weight:
Percent Weight Loss:
Minimum Transmission 25% at 20 minutes
 $Dm(corr.) = Dm - Dc = 79 - 7 = 72$

Laboratory Code: M22S3SP2 Nonflaming Test
Date: 880715
Operator: db
Initial Weight:
Final Weight:
Percent Weight Loss:
Minimum Transmission 19% at 20 minutes
 $Dm(corr.) = Dm - Dc = 95 - 9 = 86$

Laboratory Code: M22S4P2 Flaming Test
Date: 881026
Operator: db
Initial Weight: 48.6 gms
Final Weight: 47.4 gms
Percent Weight Loss: 2.5
Minimum Transmission 16% at 7 minutes
 $Dm(corr.) = Dm - Dc = 105 - 0 = 105$

Laboratory Code: M22S5SP2 Flaming Test
Date: 881122
Operator: db
Initial Weight: 49.6 gms
Final Weight: 47.4 gms
Percent Weight Loss: 4.4
Minimum Transmission 18% at 9 minutes
 $Dm(corr.) = Dm - Dc = 98 - 1 = 97$

TEST DATA FOR MATERIAL M31

Laboratory Code: M31S1SP3 Nonflaming Test
Date:
Operator: db
Initial Weight: 209.7 gms
Final Weight: 208.3 gms
Percent Weight Loss: 0.67
Minimum Transmission 78% at 20 minutes
 $Dm(corr.) = Dm - Dc = 14 - 1 = 13$

Laboratory Code: M31S2SP3 Nonflaming Test
Date:
Operator: db
Initial Weight: 209.4 gms
Final Weight: 208.8 gms
Percent Weight Loss: 0.29
Minimum Transmission 78% at 20 minutes
 $Dm(corr.) = Dm - Dc = 14 - 0 = 14$

Laboratory Code: M31S3SP3 Nonflaming Test
Date:
Operator: db
Initial Weight: 209.4 gms
Final Weight: 209.2 gms
Percent Weight Loss: 0.1
Minimum Transmission 84% at 20 minutes
 $Dm(corr.) = Dm - Dc = 10 - 0 = 10$

Laboratory Code: M31S4SP3 Flaming Test
Date: 880923
Operator: db
Initial Weight: 209.8 gms
Final Weight: 207.7 gms
Percent Weight Loss: 1
Minimum Transmission 51% at 20 minutes
 $Dm(corr.) = Dm - Dc = 39 - 0 = 39$

Laboratory Code: M31S5SP3 Flaming Test
Date: 880923
Operator: db
Initial Weight: 213.0 gms
Final Weight: 207.7 gms
Percent Weight Loss: 2.5
Minimum Transmission 51% at 20 minutes
 $Dm(corr.) = Dm - Dc = 39 - 1 = 38$

Laboratory Code: M31S6SP3 Flaming Test
Date: 880923
Operator: db
Initial Weight: 211.0 gms
Final Weight: 210.5 gms
Percent Weight Loss: 0.2
Minimum Transmission
 $Dm(\text{corr.}) = Dm - Dc = 37 - 0 = 37$

TEST DATA FOR MATERIAL M33

Laboratory Code: M33S1SP3 Nonflaming Test
Date: 880920
Operator: db
Initial Weight: 206.5 gms
Final Weight: 204.4 gms
Percent Weight Loss: 1.0
Minimum Transmission 90% at 20 minutes
 $Dm(\text{corr.}) = Dm - Dc = 6 - 0 = 6$

Laboratory Code: M33S2SP3 Nonflaming Test
Date: 880920
Operator: db
Initial Weight: 202.2 gms
Final Weight: 200.3 gms
Percent Weight Loss: 0.94
Minimum Transmission 91% at 20 minutes
 $Dm(\text{corr.}) = Dm - Dc = 5 - 0 = 5$

Laboratory Code: M33S3SP3 Nonflaming Test
Date: --
Operator: db
Initial Weight: 207.0 gms
Final Weight: 206.4 gms
Percent Weight Loss: 0.3
Minimum Transmission 93% at 20 minutes
 $Dm(\text{corr.}) = Dm - Dc = 4 - 0 = 4$

Laboratory Code: M33S4SP3 Flaming Test
Date: 880922
Operator: db
Initial Weight: 211.2 gms
Final Weight: 210.1 gms
Percent Weight Loss: 0.52
Minimum Transmission 87% at 20 minutes
 $Dm(\text{corr.}) = Dm - Dc = 8 - 0 = 8$

Laboratory Code: M33S5SP3 Flaming Test
Date: 880922
Operator: db
Initial Weight:
Final Weight:
Percent Weight:
Minimum Transmission 90% at 20 minutes
 $Dm(\text{corr.}) = Dm - Dc = 6 - 0 = 6$

Laboratory Code: M33S6SP3 Flaming Test
Date: 880922
Operator: db
 Initial Weight: 210 gms
 Final Weight
 Percent Weight:
 Minimum Transmission 91% at 20 minutes
 Dm(corr.) = Dm - Dc = 5 - 0 = 5

TEST DATA FOR MATERIAL M36

Laboratory Code: M36S1 Nonflaming Test
Date:
Operator: db
 Initial Weight: 225.4 gms
 Final Weight: 223.0 gms
 Percent Weight: 1.06
 Minimum Transmission 28% at 10 minutes
 Dm(corr.) = Dm - Dc = 73 - 1 = 72

Laboratory Code: M36S4 Flaming Test
Date: 881020
Operator: db
 Initial Weight: 223.3 gms
 Final Weight: 217.8 gms
 Percent Weight: 2.5
 Minimum Transmission 0.1% at 10 minutes
 Dm(corr.) = Dm - Dc = 396 - 2 = 394

TEST DATA FOR MATERIAL M38

Laboratory Code: M38S1 Nonflaming Test
Date: 881018
Operator: db
 Initial Weight: 225.9 gms
 Final Weight: 220.1 gms
 Percent Weight: 2.5
 Minimum Transmission 0.93% at 20 minutes
 Dm(corr.) = Dm - Dc = 400 - 4 = 396

Laboratory Code: M38S2 Nonflaming Test
Date: 881128
Operator: db
 Initial Weight: 228.7 gms
 Final Weight: 222.5 gms
 Percent Weight: 2.7
 Minimum Transmission 0.4% at 20 minutes
 Dm(corr.) = Dm - Dc = 317 - 9 = 308

Laboratory Code: M38S3 Nonflaming Test
Date: 881129
Operator: db
 Initial Weight: 225.1 gms
 Final Weight: 219.5 gms
 Percent Weight: 2.5
 Minimum Transmission 2.1% at 20 minutes
 Dm(corr.) = Dm - Dc = 353 - 3 = 350

Laboratory Code: M38S4 Flaming Test
Date: 881021
Operator: db
 Initial Weight: 222.2 gms
 Final Weight: 215.6 gms
 Percent Weight: 2.9
 Minimum Transmission 0.34% at 8 minutes
 Dm(corr.) = Dm - Dc = 326 - 6 = 320

TEST DATA FOR MATERIAL M39

Laboratory Code: M39S1 Nonflaming Test
Date: 881204
Operator: db
 Initial Weight: 215.5 gms
 Final Weight: 210.6 gms
 Percent Weight: 2.3
 Minimum Transmission 0.81% at 20 minutes
 Dm(corr.) = Dm - Dc = 276 - 9 = 267

Laboratory Code: M39S2 Nonflaming Test
Date: --
Operator: db
 Initial Weight: 221.7 gms
 Final Weight: 219.8 gms
 Percent Weight: 0.9
 Minimum Transmission 1.1% at 20 minutes
 Dm(corr.) = Dm - Dc = 259 - 9 = 250

Laboratory Code: M39S3 Nonflaming Test
Date: 881205
Operator: db
 Initial Weight: 217.4 gms
 Final Weight: 212.4 gms
 Percent Weight: 2.3
 Minimum Transmission 0.25% at 20 minutes
 Dm(corr.) = Dm - Dc = 343 - 13 = 330

Laboratory Code: M39S4 Flaming Test
Date: 881020
Operator: db
 Initial Weight: 218.1 gms
 Final Weight: 209.8 gms
 Percent Weight: 3.8
 Minimum Transmission 0.02% at 20 minutes
 Dm(corr.) = Dm - Dc = 485 - 5 = 480

TEST DATA FOR MATERIAL M40

Laboratory Code: M40S1 Nonflaming Test
Date: 881019
Operator: db
 Initial Weight: 219.3 gms
 Final Weight: 218.2 gms
 Percent Weight: 0.5
 Minimum Transmission 35% at 20 minutes
 Dm(corr.) = Dm - Dc = 60 - 1 = 59

Laboratory Code: M40S4 Flaming Test
Date: 881021
Operator: db
 Initial Weight: 225.2 gms
 Final Weight: 221.8 gms
 Percent Weight: 1.5
 Minimum Transmission 70% at 5 minutes
 Dm(corr.) = Dm - Dc = 20 - 1 = 19

TEST DATA FOR MATERIAL M41

Laboratory Code: M41S1 Nonflaming Test
Date: 881018
Operator: db
 Initial Weight: 223.2 gms
 Final Weight: 220.8 gms
 Percent Weight: 1.06
 Minimum Transmission 31% at 20 minutes
 Dm(corr.) = Dm - Dc = 67 - 7 = 60

Laboratory Code: M41S2 Nonflaming Test
Date: 881130
Operator: db
 Initial Weight: 224.7 gms
 Final Weight: 216.1 gms
 Percent Weight: 3.8
 Minimum Transmission 34% at 19 minutes
 Dm(corr.) = Dm - Dc = 62 - 1 = 61

Laboratory Code: M41S3 Nonflaming Test
Date: 881201
Operator: db
 Initial Weight: 219.7 gms
 Final Weight: 218.8 gms
 Percent Weight: 0.7
 Minimum Transmission 48% at 20 minutes
 Dm(corr.) = Dm - Dc = 42 - 1 = 41

Laboratory Code: M41S4 Flaming Test
Date: 881021
Operator: db
 Initial Weight: 221.7 gms
 Final Weight: 218.6 gms
 Percent Weight: 1.4
 Minimum Transmission 51% at 3 minutes
 Dm(corr.) = Dm - Dc = 31 - 1 - 30

TEST DATA FOR MATERIAL M102

Laboratory Code: M102S1 Nonflaming Test
Date: 881019
Operator: db
 Initial Weight: 221.7 gms
 Final Weight: 220.3.gms
 Percent Weight: 0.6
 Minimum Transmission 32% at 20 minutes
 Dm(corr.) = Dm - Dc = 65 - 1 = 64

Laboratory Code: M102S2 Nonflaming Test
Date: 881206
Operator: db
 Initial Weight: 223.3 gms
 Final Weight: 222.0 gms
 Percent Weight: 0.6
 Minimum Transmission 42% at 20 minutes
 Dm(corr.) = Dm - Dc = 50 - 2 = 48

Laboratory Code: M102S3 Nonflaming Test
Date: 881206
Operator: db
 Initial Weight: 218.1 gms
 Final Weight: 217.2 gms
 Percent Weight: 0.4
 Minimum Transmission 32% at 20 minutes
 Dm(corr.) = Dm - Dc = 65 - 2 = 63

Laboratory Code: M102S4 Flaming Test
Date: 881021
Operator: db
 Initial Weight: 224.8 gms
 Final Weight: 220.6 gms
 Percent Weight: 1.8
 Minimum Transmission 8.7% at 11 minutes
 Dm(corr.) = Dm - Dc = 140 - 1 = 139

TEST DATA FOR MATERIAL M104

Laboratory Code: M104S1 Nonflaming Test
Date: 881019
Operator: db
Initial Weight: 221.6 gms
Final Weight: 220.0 gms
Percent Weight: 0.5
Minimum Transmission 43% at 20 minutes
 $Dm(corr.) = Dm - Dc = 48 - 1 = 47$

Laboratory Code: M104S2 Nonflaming Test
Date: 881205
Operator: db
Initial Weight: 227.8 gms
Final Weight: 226.9 gms
Percent Weight: 0.4
Minimum Transmission 44% at 20 minutes
 $Dm(corr.) = Dm - Dc = 47 - 1 = 46$

Laboratory Code: M104S3 Nonflaming Test
Date: 881206
Operator: db
Initial Weight: 226.0 gms
Final Weight: 225.2 gms
Percent Weight: 0.4
Minimum Transmission 37% at 20 minutes
 $Dm(corr.) = Dm - Dc = 57 - 1 = 56$

Laboratory Code: M104S4 Flaming Test
Date: 881020
Operator: db
Initial Weight: 226.1 gms
Final Weight: 221.7 gms
Percent Weight: 1.9
Minimum Transmission 15% at 9.5 minutes
 $Dm(corr.) = Dm - Dc = 109 - 1 = 108$